LOW DROPOUT VOLTAGE REGULATOR

■ GENERAL DESCRIPTION
The NJM2880 is a low dropout voltage regulator. Advanced Bipolar technology achieves low noise, high ripple rejection and low quiescent current.

■ FEATURES
- High Ripple Rejection 70dB typ. (f=1kHz, Vo=3V Version)
- Output Noise Voltage Vno=30µVrms typ. (Cp=0.01µF)
- Output capacitor with 1.0µF ceramic capacitor
- Output Current Io(max.)=300mA
- High Precision Output Vo±1.0%
- Low Dropout Voltage 0.10V typ. (Io=100mA)
- ON/OFF Control (Active High)
- Internal Short Circuit Current Limit
- Internal Thermal Overload Protection
- Bipolar Technology
- Package Outline SOT-89-5

■ PIN CONFIGURATION

■ EQUIVALENT CIRCUIT
### OUTPUT VOLTAGE RANK LIST

<table>
<thead>
<tr>
<th>Device Name</th>
<th>Vout</th>
<th>Device Name</th>
<th>Vout</th>
<th>Device Name</th>
<th>Vout</th>
</tr>
</thead>
<tbody>
<tr>
<td>NJM2880U/U1-15</td>
<td>1.5V</td>
<td>NJM2880U/U1-28</td>
<td>2.8V</td>
<td>NJM2880U/U1-44</td>
<td>4.4V</td>
</tr>
<tr>
<td>NJM2880U/U1-16</td>
<td>1.6V</td>
<td>NJM2880U/U1-285</td>
<td>2.85V</td>
<td>NJM2880U/U1-45</td>
<td>4.5V</td>
</tr>
<tr>
<td>NJM2880U/U1-18</td>
<td>1.8V</td>
<td>NJM2880U/U1-03</td>
<td>3.0V</td>
<td>NJM2880U/U1-48</td>
<td>4.8V</td>
</tr>
<tr>
<td>NJM2880U/U1-21</td>
<td>2.1V</td>
<td>NJM2880U/U1-32</td>
<td>3.2V</td>
<td>NJM2880U/U1-05</td>
<td>5.0V</td>
</tr>
<tr>
<td>NJM2880U/U1-25</td>
<td>2.5V</td>
<td>NJM2880U/U1-33</td>
<td>3.3V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NJM2880U/U1-26</td>
<td>2.6V</td>
<td>NJM2880U/U1-38</td>
<td>3.8V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NJM2880U/U1-27</td>
<td>2.7V</td>
<td>NJM2880U/U1-04</td>
<td>4.0V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>RATINGS</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input Voltage</td>
<td>V_IN</td>
<td>+14</td>
<td>V</td>
</tr>
<tr>
<td>Control Voltage</td>
<td>V_CONT</td>
<td>+14(*1)</td>
<td>V</td>
</tr>
<tr>
<td>Power Dissipation</td>
<td>P_D</td>
<td>350</td>
<td>mW</td>
</tr>
<tr>
<td>Operating Temperature</td>
<td>Topr</td>
<td>-40 ~ +85</td>
<td>°C</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>Tstg</td>
<td>-40 ~ +125</td>
<td>°C</td>
</tr>
</tbody>
</table>

(*1) When input voltage is less than +14V, the absolute maximum control voltage is equal to the input voltage.

Operating voltage

\[ V_{IN}=+2.3 \sim +14V \] (In case of Vo<2.1V version)

### ELECTRICAL CHARACTERISTICS

(Vo>2.0V version:
\[ V_{IN}=Vo+1V, Co=0.1\mu F: Vo\geq 2.7V (Co=2.2\mu F: Vo\leq 2.6V), Cp=0.01\mu F, Ta=25°C \]

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITION</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Voltage</td>
<td>Vo</td>
<td>Io=30mA</td>
<td>-1.0%</td>
<td>-</td>
<td>+1.0%</td>
<td>V</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>I_Q</td>
<td>Io=0mA, expect I_cont</td>
<td>-</td>
<td>120</td>
<td>180</td>
<td>µA</td>
</tr>
<tr>
<td>Quiescent Current at Control OFF</td>
<td>I_Q(Off)</td>
<td>V_CONT=0V</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td>Output Current</td>
<td>I_O</td>
<td>Vo-0.3V</td>
<td>300</td>
<td>400</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>Line Regulation</td>
<td>ΔVo/ΔV_IN</td>
<td>V_IN=Vo+1V \sim Vo+6V, Io=30mA</td>
<td>-</td>
<td>-</td>
<td>0.10</td>
<td>%/V</td>
</tr>
<tr>
<td>Load Regulation</td>
<td>ΔVo/ΔI_o</td>
<td>Io=0 \sim 300mA</td>
<td>-</td>
<td>-</td>
<td>0.03</td>
<td>%/mA</td>
</tr>
<tr>
<td>Dropout Voltage</td>
<td>ΔV_GO</td>
<td>Io=100mA</td>
<td>0.10</td>
<td>0.18</td>
<td>-</td>
<td>V</td>
</tr>
<tr>
<td>Ripple Rejection</td>
<td>RR</td>
<td>ein=200mVrms,f=1kHz, Io=10mA Vo=3V Version</td>
<td>-</td>
<td>70</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Average Temperature Coefficient of Output Voltage</td>
<td>ΔVo/ΔTa</td>
<td>Ta=0\sim -85°C, Io=10mA</td>
<td>-</td>
<td>±50</td>
<td>-</td>
<td>ppm/°C</td>
</tr>
<tr>
<td>Output Noise Voltage</td>
<td>V_NO</td>
<td>f=10Hz \sim 80kHz, Io=10mA, Vo=3V Version</td>
<td>-</td>
<td>30</td>
<td>-</td>
<td>µVrms</td>
</tr>
<tr>
<td>Control Voltage for ON-state</td>
<td>V_CONT(ON)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control Voltage for OFF-state</td>
<td>V_CONT(OFF)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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(Vo≤2.0V version):
\[ V_{IN} = V_o + 1V, \ C_{IN} = 0.1\mu F, \ Co = 2.2\mu F : V_o \geq 1.9V (Co=4.7\mu F : V_o \leq 1.8V), \ Cp = 0.01\mu F, \ Ta = 25^\circ C]\n
<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>SYMBOL</th>
<th>TEST CONDITION</th>
<th>MIN.</th>
<th>TYP.</th>
<th>MAX.</th>
<th>UNIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Voltage</td>
<td>Vo</td>
<td>Io=30mA</td>
<td>-1.0%</td>
<td>-</td>
<td>+1.0%</td>
<td>V</td>
</tr>
<tr>
<td>Quiescent Current</td>
<td>Io</td>
<td>Io=0mA, expect Icont</td>
<td>-</td>
<td>120</td>
<td>180</td>
<td>\mu A</td>
</tr>
<tr>
<td>Quiescent Current at Control OFF</td>
<td>I_Q(OFF)</td>
<td>V_{CONT}=0V</td>
<td>-</td>
<td>-</td>
<td>100</td>
<td>nA</td>
</tr>
<tr>
<td>Output Current</td>
<td>Io</td>
<td>V_o-0.3V</td>
<td>300</td>
<td>400</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>Line Regulation</td>
<td>\Delta V_o/\Delta V_{IN}</td>
<td>V_{IN}=V_o+1V - V_o+6V, Io=30mA</td>
<td>-</td>
<td>-</td>
<td>0.10</td>
<td>%/V</td>
</tr>
<tr>
<td>Load Regulation</td>
<td>\Delta V_o/\Delta I_o</td>
<td>Io=0 – 300mA</td>
<td>-</td>
<td>-</td>
<td>0.03</td>
<td>%/mA</td>
</tr>
<tr>
<td>Ripple Rejection</td>
<td>RR</td>
<td>ein=200mVrms, f=1kHz, Io=10mA V_o=1.8V Version</td>
<td>-</td>
<td>74</td>
<td>-</td>
<td>dB</td>
</tr>
<tr>
<td>Average Temperature Coefficient of Output Voltage</td>
<td>\Delta V_o/\Delta T_a</td>
<td>T_a=0–85^\circ C, Io=10mA</td>
<td>-</td>
<td>±50</td>
<td>-</td>
<td>ppm/^\circ C</td>
</tr>
<tr>
<td>Output Noise Voltage</td>
<td>V_NO</td>
<td>f=10Hz~80kHz, Io=10mA, V_o=1.8V Version</td>
<td>-</td>
<td>18</td>
<td>-</td>
<td>\mu V/\text{rms}</td>
</tr>
<tr>
<td>Control Voltage for ON-state</td>
<td>V_{CONT(ON)}</td>
<td>1.6</td>
<td>-</td>
<td>-</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Control Voltage for OFF-state</td>
<td>V_{CONT(OFF)}</td>
<td>-</td>
<td>-</td>
<td>0.6</td>
<td>V</td>
<td></td>
</tr>
</tbody>
</table>

The above specification is a common specification for all output voltages. Therefore, it may be different from the individual specification for a specific output voltage.

**TEST CIRCUIT**

\[*2 \ 1.9V \leq V_o \leq 2.6V \text{ version : } Co=2.2\mu F (\text{ceramic}) \]
\[V_o \leq 1.8V \text{ version : } Co=4.7\mu F (\text{ceramic})\]
**TYPICAL APPLICATION**

1. In the case where ON/OFF Control is not required:
   - Connect control terminal to VIN terminal.
   
   ![Diagram](image)
   
   *3 1.9V≤Vo≤2.6V version : Co=2.2µF
   *3 Vo≤1.8V version : Co=4.7µF

   - State of control terminal:
     - “H” → output is enabled.
     - “L” or “open” → output is disabled.

   - Noise bypass Capacitance Cp
     Noise bypass capacitance Cp reduces noise generated by band-gap reference circuit. Noise level and ripple rejection will be improved when larger Cp is used. Use of smaller Cp value may cause oscillation. Use the Cp value of 0.01µF greater to avoid the problem.

2. In use of ON/OFF CONTROL:
   - The current flow into the control terminal while the IC is ON state (I_{CONT}) can be reduced when a pull up resistance "R" is inserted between VIN and the control terminal.
   - The minimum control voltage for ON state (V_{CONT(ON)}) is increased due to the voltage drop caused by I_{CONT} and the resistance "R". The I_{CONT} is temperature dependence as shown in the "Control Current vs. Temperature" characteristics. Therefore, the resistance "R" should be carefully selected to ensure the control voltage exceeds the V_{CONT(ON)} over the required temperature range.
ELECTRICAL CHARACTERISTICS

NJM2880_3.0V
Output Voltage vs. Input Voltage

@Ta=25°C
Co=1.0μF(Ceramic)
Cp=0.01μF

Output Voltage : Vo (V)
Input Voltage : VIN (V)

1.2 1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 3 3.2
0 500 1000 1500 2000 2500 3000
Output Voltage : Vo (V)

Output Voltage vs. Output Current

@Ta=25°C
VIN=4.0V
Co=1.0μF(Ceramic)
Cp=0.01μF

Output Current : Io (mA)

0 0.1 0.2 0.3 0.4 0.5
0 100 200 300 400 500
Dropout Voltage : dV (V)

Ground Pin Current vs. Output Current

@Ta=25°C
VIN=4.0V
Co=1.0μF(Ceramic)
Cp=0.01μF

Ground Pin Current : Ignd (mA)
Output Current : Io (mA)

0 0.5 1 1.5 2 2.5 3 3.5 4
0 100 200 300 400 500

Control Current vs. Control Voltage

@Ta=25°C
VIN=4.0V
Co=1.0μF(Ceramic)
Cp=0.01μF
Io=30mA

Control Current : Icont (mA)
Control Voltage : Vcont (V)

0 10 20 30 40 50 60
0 0.5 1 1.5 2 2.5 3 3.5 4

Output Voltage vs. Control Voltage

@Ta=25°C
VIN=4.0V
Co=1.0μF(Ceramic)
Cp=0.01μF

Output Voltage : Vo (V)
Control Voltage : Vcont (V)

0 0.5 1 1.5 2 2.5 3 3.5 4
0 0.5 1 1.5 2 2.5 3

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ELECTRICAL CHARACTERISTICS

**Equivalent Series Resistance vs. Output Current**

![Graph showing Equivalent Series Resistance vs. Output Current](image)

**Output Voltage vs. Temperature**

![Graph showing Output Voltage vs. Temperature](image)

**Control Voltage vs. Temperature**

![Graph showing Control Voltage vs. Temperature](image)

**Control Current vs. Temperature**

![Graph showing Control Current vs. Temperature](image)
ELECTRICAL CHARACTERISTICS

**Quiescent Current v.s. Temperature**

- **@:** $V_{in}=4V$
- Output is open.
- $C_o=1\mu F$ (Ceramic)
- $C_p=0.01\mu F$

**Short Circuit Current v.s. Temperature**

- **@:** $V_{in}=4V$
- Output is short to ground.
- $C_o=1\mu F$ (Ceramic)
- $C_p=0.01\mu F$

**Line Regulation v.s. Temperature**

- **@:** $V_{in}=4-9V$
- $I_o=30mA$
- $C_o=1\mu F$ (Ceramic)
- $C_p=0.01\mu F$

**Load Regulation v.s. Temperature**

- **@:** $V_{in}=4V$
- $I_o=0-300mA$
- $C_o=1\mu F$ (Ceramic)
- $C_p=0.01\mu F$

**Output Voltage v.s. Temperature**

- **@:** $V_{in}=4V$
- $I_o=30mA$
- $C_o=1\mu F$ (Ceramic)
- $C_p=0.01\mu F$
ELECTRICAL CHARACTERISTICS

ON/OFF Transient Response without Load

Control Voltage
Output Voltage

@Ta=25°C
VIN=4V
Co=1µF
Cp=0.01µF
Io=0mA

Control Voltage
Output Voltage

@Ta=25°C
VIN=4V
Co=1µF
Cp=0.01µF
Io=30mA

Line Transient Response

Control Voltage
Output Voltage

@Ta=25°C
Co=1µF
Io=30mA

Output Voltage : Vo [V]
Control Voltage : Vo [V]
Time : t [S]

Input Voltage : VIN [V]
Output Voltage : Vo [V]
Output Current : Io [mA]
Time : t [µS]

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